IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	RICHAUD et al.
Title	RIPPLED SURFACE STOPPER ROD SYSTEM
Serial Number	10/576,999
Filing Date	25 April 2006
Art Unit	1793
Examiner	Scott R. Kastler
Attorney Docket No.	1461 PCT/US

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AFFIDAVIT UNDER 37 C.F.R. § 1.132

I, Johan Richaud, hereby swear and state that:

1. I have been active in research and development in the field of fluid mechanics as applied to the flow of liquid metals, and in particular as applied to the flow of molten, i.e., liquid, steel for the last 8 years.
2. I am currently an employee of the Vesuvius Group, which manufactures a broad range of refractory products for molten metal flow control and containment, and has greater than $1 billion in worldwide refractory sales.
3. I received an Engineering degree in technical ceramics and glasses, equivalent to a master degree in Ceramic Science, from E.N.S.C.I. - a three-year National School of Engineering - Limoges, France in 1995.
4. I am the author or co-author of technical papers, presented at meetings and symposia, relating to liquid metal flow and iron and steel production.
5. I hold four US patents and many foreign patents, particularly relating to refractory articles and related processes used in the steel making and steel casting industries.

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6. I am very familiar with the dynamics of steel casting and how molten metal flows through the entire casting process.

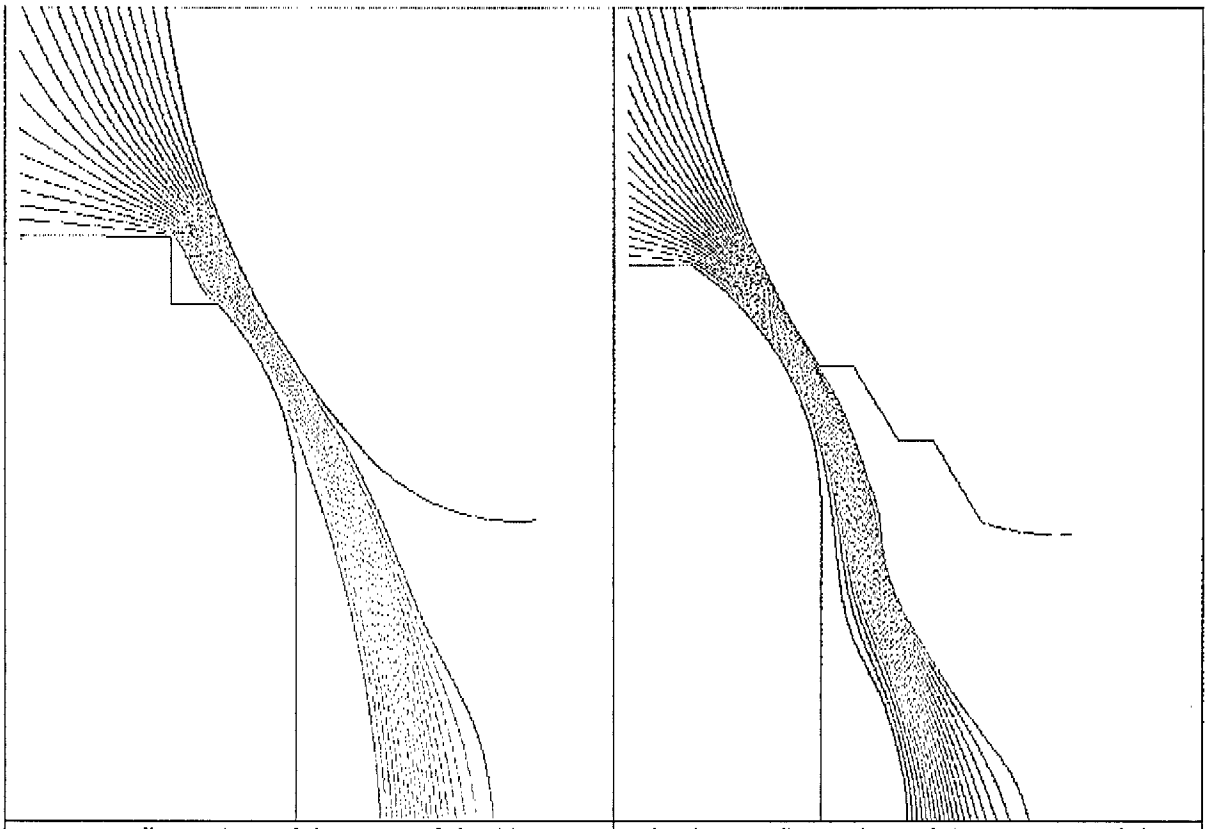
7. I have conducted numerical simulations of flow patterns of molten metal, have witnessed the use of refractory articles in commercial operation, and am very familiar with the problems arising in various refractory articles.

8. I am co-inventor of the subject matter described in the present application, U.S. Patent Application No. 10/576,999 ("the '999 application"), which was published as U.S. Patent Publication No. 2007/0120299.

9. I am the inventor of the subject matter described in International Application No. PCT/US02/09245, which was published as WO 02/081123 A2 ("the '123 publication"). I am familiar with the content of the '123 publication.

10. I have performed analyses of the flow patterns produced by devices of the present invention and by a device having the geometry taught by the '123 publication.

11. I have compared the flow patterns of ripple stopper geometry according to the present invention with seat step geometry of the '123 publication. The seat step geometries of the '123 publication provide two or more constrictions in the flow path of the device containing them. For comparisons of flow patterns identical mesh size (0.25 mm) and identical inlet and outlet boundary conditions were used, the step was cut into the nozzle seat, and the ripples were cut from the multi-radius stopper nose profile. In the step configuration of the '123 publication, the step was found to deflect the streamlines upstream of the step. The step forces the streamlines to deviate towards the nozzle seat where the step is located. In the ripple configuration of the present invention, the ripples force the streamlines to deviate away from the stopper nose where the ripples are located. The following streamline configurations were observed:



Step Configuration of the Seat of the '123 Publication – Path Lines	Ripple Configuration of the Stopper of the Present Invention – Path Lines

12. The ripple stopper geometry according to the present invention and the seat step geometry of the '123 publication exhibited different downstream flow properties. The step does not modify the trajectory of streamlines downstream, whereas the ripple surface stabilizes a recirculation region below the stopper nose that interacts with the streamline trajectories.

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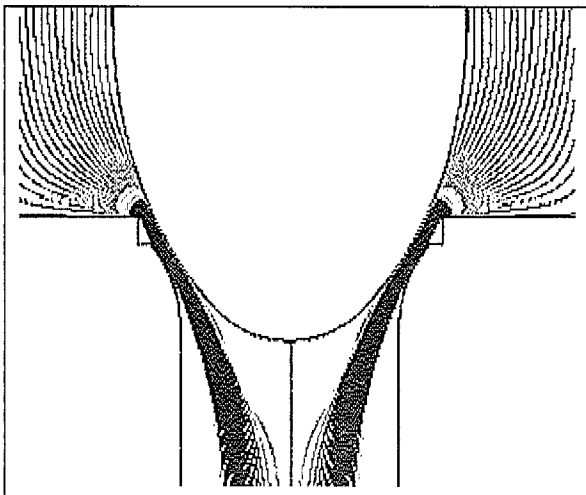	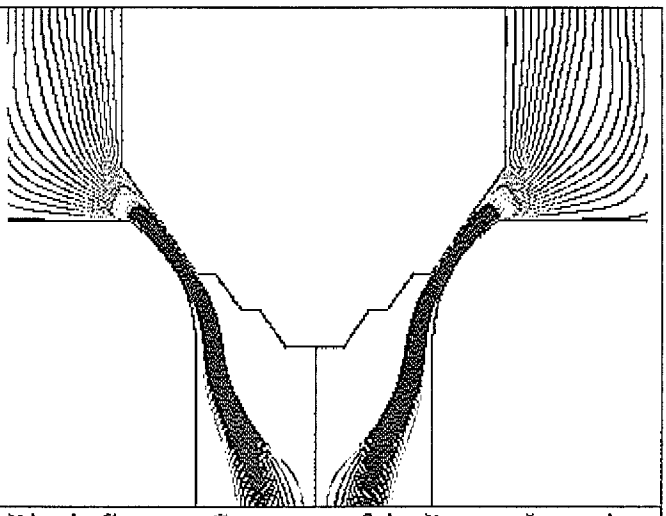
Seat Step Geometry of the '123 Publication -- Path Lines	Ripple Stopper Geometry of the Present Invention -- Path Lines

13. The flow patterns of the ripple stopper geometry according to the present invention and the seat step geometry of the '123 publication are distinguishable. The seat step geometry of the '123 publication produces a region above the step where particles tend to accumulate. The step seat geometry of the '123 publication does not promote a strong recirculation below the stopper nose that will promote flow detachment from the nose. In contrast, in the ripple stopper geometry of the present invention, the ripples promote the generation of a powerful circulatory flow downstream of the ripples that detaches the flow from, and directs the flow away from, the nose. The recirculation zone is below the ripples and deviation is away from the ripples; these factors both decrease the likelihood of accumulation of material on the stopper or nozzle.

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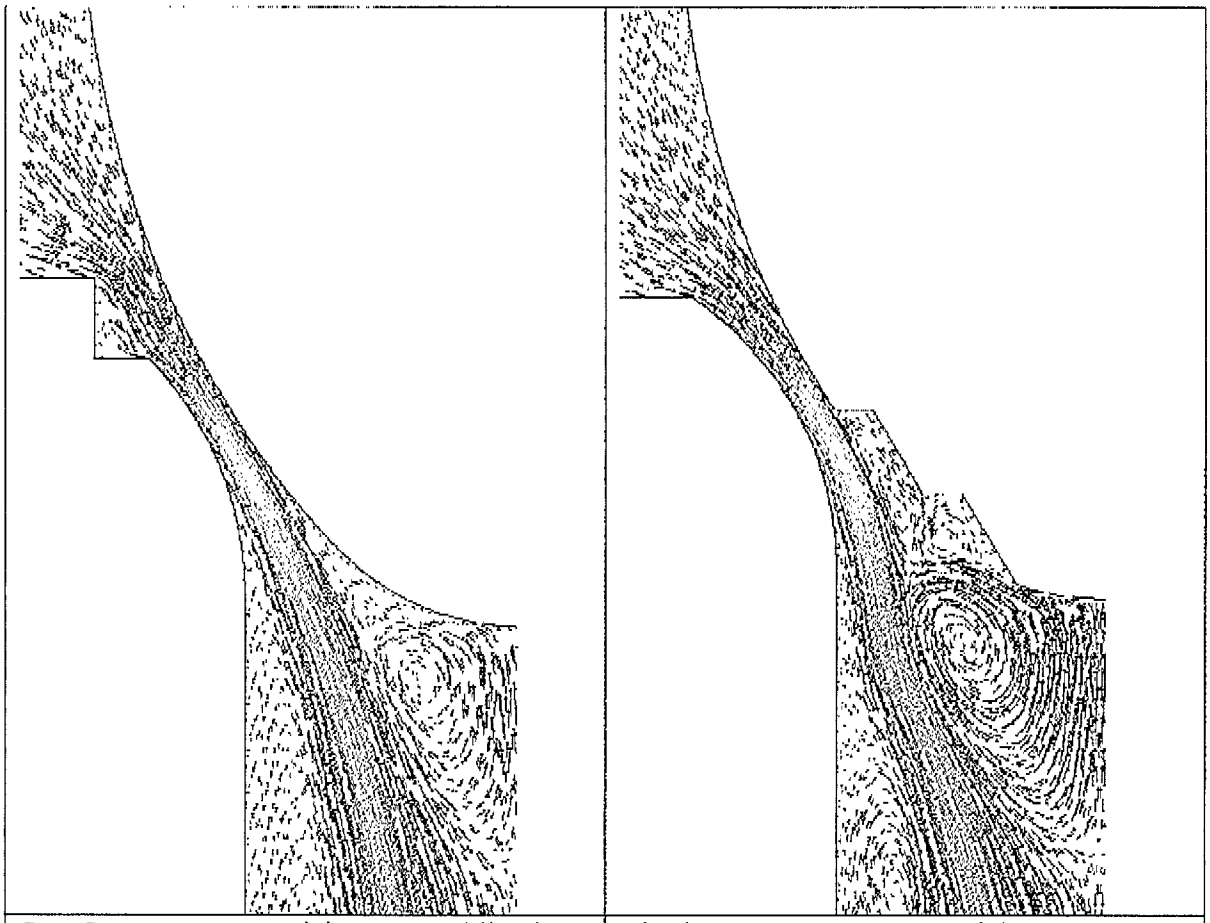

Seat Step Geometry of the '123 Publication - Vectors	Ripple Stopper Geometry of the Present Invention - Vectors

14. I have compared the flow patterns of seat ripple geometry according to the present invention with seat step geometry of the '123 publication. For comparisons of flow patterns identical mesh size (0.25 mm) and identical inlet and outlet boundary conditions were used, the step was cut into the nozzle seat for the '123 publication configuration, and the ripples were cut into the nozzle seat for the configuration of the present invention so that only a single constriction was produced in the flow channel. The ripples along the seat of the configuration of the present invention were seen to promote flow detachment. The following flow patterns were observed:

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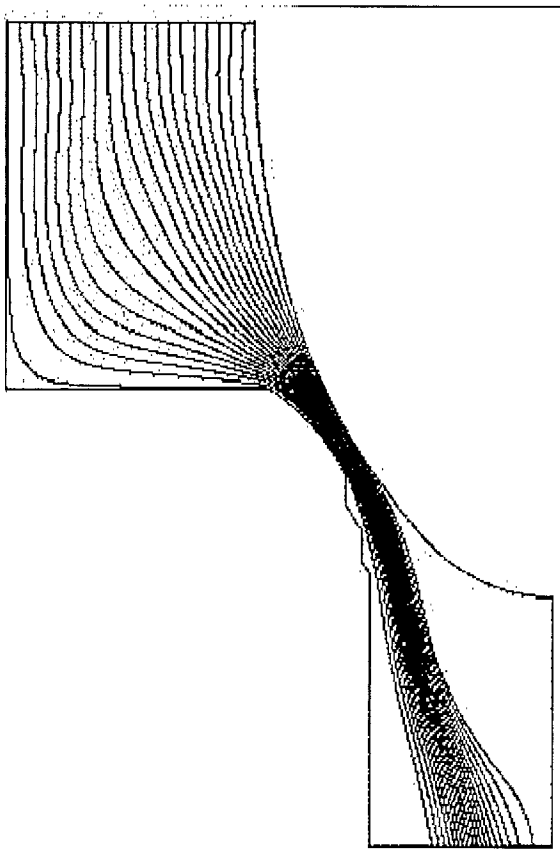
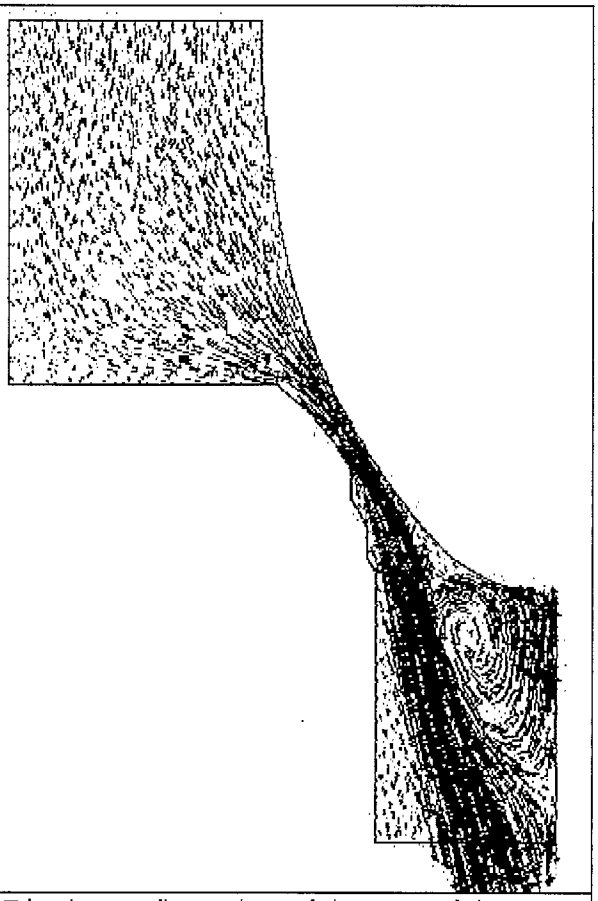


Ripple Configuration of the Seat of the Present Invention – Path Lines



Ripple Configuration of the Seat of the Present Invention – Vectors

15. The seat ripple geometry according to the present invention and the seat step geometry of the '123 publication exhibited different downstream flow properties. As in the case of the ripple stopper geometry of the present invention, the seat ripple geometry of the present invention stabilizes a recirculation region that interacts with the streamline trajectories. The seat step geometry of the '123 publication does not modify the trajectory of streamlines downstream.

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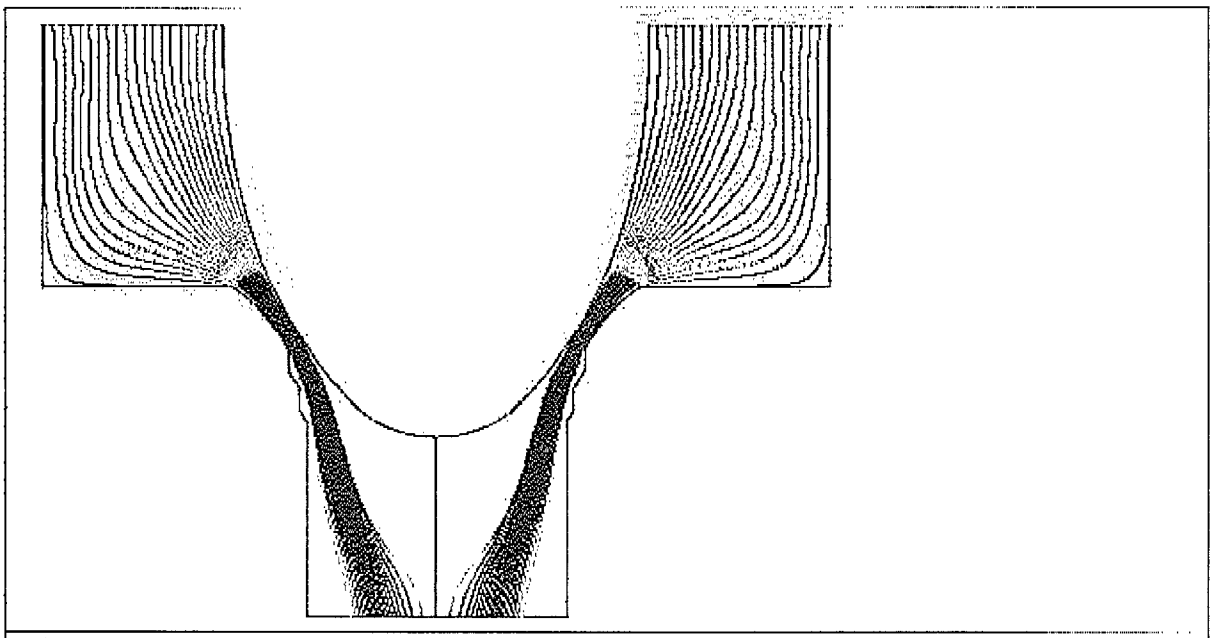

Ripple Configuration of the Seat of the Present Invention – Path Lines

16. I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-referenced application or any patent issuing thereon.

Date: April 5th 2009

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Johan Richaud

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April 5th 2009